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VERTEBRATE PESTS OF UK AGRICULTURE: PRESENT PROBLEMS AND FUTURE SOLUTIONS

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ABSTRACT: The status of damage by vertebrate pests to growing and stored agricultural crops is reviewed in the light of changing patterns of agricultural practice and land use within the UK. Significant problems and existing management techniques are briefly discussed. The results of recent research by the Agricultural Department and Advisory Service (ADAS) of the Ministry of Agriculture, Fisheries and Food are explored to indicate the future direction of vertebrate pest management to reduce crop damage. Recent changes in legislation and public attitudes impose constraints on some of the approaches to solving problems. The continued role of traditional control methods is considered together with new opportunities and requirements to exploit the ecology and behaviour of pest species in order to reduce damage.

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INTRODUCTION

Approximately 76 percent of the land surface of the UK is used for agriculture. Permanent pasture and rough grassland account for 60 percent of this and 37 percent is under arable crops. Cereals form three-quarters of the total tillage. Instead of continuous, unbroken cultivation, much of this lowland and upland farmland is a rich mosaic of different habitats with woods, copses, hedges, marsh and bog amidst cropped and grassland areas. The resultant diversity provides ideal harbourage and nesting habitat for a range of mammals and birds which through their conflict with man's agricultural activities attain the status of pests. Damage may result in economic loss to growing crops, particularly cereals and oilseed rape, high-value vegetable and fruit crops, spoilage of stored commodities and structural damage, and direct competition with grazing stock on grassland. Changing land use is continually modifying the agricultural landscape and changing the habitat mix with consequent effect on pest species and their impact on growing crops. Against a background of surplus food production, various incentives to remove land from crop production either temporarily or permanently include set-aside and farm woodland schemes. The consequent provision of harbourage adjacent to productive cropping areas will be exploited by pest species and must be taken into account in future management strategies. Another dimension is the increasing public concern and legislative changes over control methods and humaneness of techniques. As a requirement of the Food and Environment Protection Act (1985) and the consequent Control of Pesticides Regulations (1986), in addition to safety and efficacy, the humaneness of a vertebrate pesticide must be assessed during the registration process. It is therefore considered timely to review the current position regarding vertebrate pest management and to consider future trends. The ADAS Central Science Laboratory of the Ministry of Agriculture, Fisheries and Food (MAFF) has played a prominent role in developing successful management techniques for vertebrate pests through its Tolworth and Worplesdon Laboratories for the last 40 years or so.

RABBITS

The European rabbit (Oryctolagus cuniculus) is the most important mammal pest capable of considerable damage to a wide range of arable crops, particularly winter cereals, horticultural crops and grass. Whilst research over the last 40 years has led to a sound understanding of rabbit ecology and population biology and has provided insight into some of the important regulatory factors (e.g., Trout and Tittensor 1989), progress on their successful management and control has been less spectacular. The rabbit population was decimated in the 1950s by myxomatosis which reduced numbers by more than 99 percent. Currently the national rabbit population is estimated at some 30 percent of the pre-myxomatosis level but locally numbers may have recovered (Trout et al. 1986). Attenuation of the virus strains combined with the spread of genetic resistance means that the disease will not control rabbits to the same extent again (Ross et al. 1989). Myxomatosis is capable of exerting a regulatory effect as demonstrated by a carefully controlled field experiment on a MAFF farm. Rabbit fleas, the principal vector, were systematically reduced twice by the application of insecticide to rabbit burrows followed by the reintroduction of fleas. Rabbit numbers more than doubled when flea numbers (and disease prevalence) were reduced and dropped during the rises in flea numbers. The deliberate spread of myxomatosis to control rabbits is, however, illegal in the UK. A more recent problem, viral haemorrhagic disease, which can devastate domestic rabbit production, has killed wild rabbits in Iberia. It has not yet been identified in the UK.

The fundamental problem is that there is no panacea to the control of rabbits in the UK but successful management depends on the integration of appropriate techniques according to the specific situation. To have maximum effect, control should be carried out to reduce adult numbers during the winter months and before the onset of breeding. Gassing is a widely used as the most cost-effective way of controlling rabbits but requires access to the burrows. Best done in October as the ground vegetation dies back, gassing is more effective if coordinated locally over a wide area. In the light of recent UK legislative requirements covering pesticide approval, the humaneness of available fumigants (hydrogen cyanide and phosphine) is being reviewed. Efficacy varies with soil type. Where a high-value (e.g., vegetable) crop is being damaged, control at the site of damage can be effective using baited live-trapping and the humane dispatch of captured rabbits. A suitable cage-trap and baiting system has been developed by ADAS enabling the safe release of nontarget species. Trap spacing and inter-bait distances are based on behavioural studies of rabbits grazing cereal fields (Cowan et al. 1989). Excluding rabbits from vulnerable crops can be done by either wire-mesh or electric fencing. Extensive work in this Laboratory has developed the UK standard and has demonstrated that properly installed fencing can keep about 80 percent of rabbits out of protected fields (McKillop and Wilson 1987, McKillop et al. 1988). Traditional methods of control such as ferreting and shooting have their uses on a local scale but are labour intensive and are best regarded as sport.

Current research by ADAS is focussed on the strategic identification of factors limiting rabbit populations with the objective of combining modeling and an experimental approach to develop flexible, integrated control packages. The intention is that these should be applicable to areas of any size and varied to meet local requirements. This work is greatly facilitated by the recent enclosure of a 30-ha research area on an ADAS farm in southern England. Fenced off from the rest of the farm, this area has been subdivided with rabbit-proof fencing to give replicated plots of 0.8 ha, larger fields and forestry plots. Crop damage assessment is being carried out with known numbers of rabbits in winter cereals. Efficacy and humaneness studies can now be conducted in the field under closely controlled conditions impossible in open farmland sites. The impact of rabbits on the establishment of hardwood trees, and their protection, is being critically determined in newly planted woodland plots exposed to different grazing pressure from rabbits. Using this combination of field experimentation and predictive modeling, it is hoped that integrated management packages can be developed in a realistic time frame.

There remains a major gap in the range of suitable techniques to apply to certain habitat combinations where existing methods to control rabbits are not appropriate. For example, in permanent pasture adjacent to rough grazing and hill areas, rabbits may become extremely numerous and serious competitors with livestock for limited grazing. They may prevent extensive heather regeneration in upland areas where the economics of rough grazing on marginal land is already poor. In such situations a targeted poisoning technique could be very effective provided that it was both humane and safe to nontarget animals (both through primary access to toxic bait or to secondary poisoning through predation or scavenging of poisoned rabbits). Whether such a technique is acceptable is a decision for society to take when presented with all the facts. In the meantime, work is continuing to establish the feasibility of this approach in the UK farming landscape.

The rabbit is one important pest species which can be predicted to benefit from ongoing changes in land use resulting from set-aside and the establishment of farm woodland. The provision of extra harbourage adjacent to cropped fields will increase the need to ensure effective control of rabbits at the planning and establishment phase to reduce crop damage. The use of chemical repellents sprayed around the margins of cereal fields may have a use in deterring rabbits from grazing the headland, their normal route of entry into a field. Under extreme conditions it may be necessary to consider altering local cropping plans to remove high-value crops from adjacent non-agricultural areas taken out of production.

WOODPIGEONS

The woodpigeon (Columba palumbus) is the most important bird pest of growing crops causing particular damage to brassicas, principally oilseed rape (Inglis et al. 1989). Scientists from this laboratory have monitored the pigeon population on a 1000-ha block of farmland in eastern England for 26 years. Analysis of population, dietary, and crop preference data for this period has revealed the direct influence of cropping pattern on the birds and therefore their potential to damage crops. During the first 10 years of this study set up in 1960 (Murton 1965) the winter woodpigeon population was found to be determined by two crops. How many pigeons remained in the area in December depended on the size of relatively small areas of winter cereal sowings. Population survival during the winter was determined by the area of clover available in January and February. Murton et al. (1974) showed clearly that shooting did not have a regulatory effect on pigeon numbers since at that stage they were limited by their winter food supply. During the 10 years from 1975, the number of birds remaining in November was determined by the availability of grain on stubbles and sowings. However, the major difference was the introduction of winter oilseed rape which now provides a superabundant food source replacing clover. The area of rape available in December determines the winter population size which then remains stable during the rest of the winter (Inglis et al. 1990). Birds no longer appear to be food limited. The prediction from the derived population model for this period is that coordinated and organised shooting could now have a significant effect on local winter pigeon numbers. The winter woodpigeon population fell from the 1960s to the mid-1970s when the introduction of oilseed rape coincided with a dramatic increase in population. This was checked by a heavy shooting campaign in 1984.

The population model developed from this 26-year run of data will be used to predict the effect of continuing changes in cropping patterns and the effects of land use changes. There is a suggestion that woodpigeons in the study area are now nest limited during the breeding season. The provision of suitable nesting structures by farm woodland planted adjacent to productive cropping areas may worsen the pest potential of this bird. Woodpigeon numbers will continue to be monitored by this Laboratory and the population models validated and refined.

A variety of scaring techniques are in use to deter woodpigeons (and other birds) from damaging crops. Unless the scaring attempt is actively managed and the field positions of scaring devices regularly changed, birds will habituate rapidly with consequent loss of effectiveness. Use of repetitive sonic scarers is subject to constraints under noise pollution control, an increasingly contentious area. Scaring devices based on species specific alarm signals can be extremely effective (Inglis and Isaacson 1984) but there has so far been little take-up by industry.

A publicly more acceptable management technique is to modify the behaviour of the pest by persuading it that the crop is unpalatable and further may prove not to be nutritional. Through focused research on bullfinches (Pyrrhula pyrrhula) and their predation on selected cultivars of pears, ADAS research has led to the investigation of secondary plant compounds and their potential as repellents for bird pests and their active development. This approach is described more fully by Crocker in this Conference. The manipulation of the pest's behaviour through the managed application of chemical repellents at critical stages of a growing crop, or the initial learning stages of crop interactions for migratory species, may prove to be a humane, effective, and acceptable management technique. Initially attention is focused on the woodpigeon but developments are being tested against other species including geese and rabbits.

STARLINGS

The ubiquitous starling (Sturnus vulgaris), though not a major pest in the UK, can cause significant economic losses at intensive livestock units where high protein concentrates may provide a ready food source for winter flocks (Feare 1989). Local control of bird numbers is not a management option in the UK Previous attempts to remove starlings from a farm by trapping failed to effectively reduce numbers over a winter. Mass killing of birds is publicly unacceptable and, in view of bird mobility, would be an ineffective technique. Although potential disease transmission is associated with feeding at livestock units through attendant fouling and contamination by droppings, actual evidence of transmission is uncommon. Modifications of management practices, such as reducing barley particle size in silage, selection of nonpreferred pellet sizes, changing the stock feeding routines to avoid times when starlings are present, can all reduce the problem. As a result of ADAS research, plastic exclusion strips were successfully developed to prevent starling (and other bird) gaining access to the fronts of stock sheds while permitting the through movement of farm machinery (Feare and Swannack 1977). Subsequent food losses to birds can be greatly reduced. A recent development being monitored is the introduction of large intensive cattle yards which provide a major source of concentrated pellets. These could prove a great attraction to starlings and present a difficult problem to overcome.

GEESE

Under international and domestic legislation, migrating geese of several species are fully protected in the UK and may only be shot under license as part of scaring activities. These large grazing herbivores can cause serious economic damage to growing crops, particularly winter cereals and oilseed rape. Until the early 1970s dark-bellied Brent geese (Branta bernicla bernicla) which winter in the UK on the coast of eastern and southern England, fed exclusively on algae in the intertidal zone and saltmarsh plants. Since 1973, however, the Brent geese have progressively changed their behaviour and now obtain much of their grazing from adjacent farmland. Growing crops and pasture may be visited by local flocks of several thousand birds. This species is considered to be of high international wildlife conservation interest and is vulnerable to poor breeding seasons in Siberia. However, it may conflict directly with man's agricultural activities. Detailed research by ADAS on feeding geese in East Anglia has established the pattern of daily movements during the winter in relation to the exploitation of both natural and agricultural food sources. Scaring is a costly option to keep geese off vulnerable crops, requiring considerable management to prevent habituation. However, the research results have identified that the provision of acceptable alternative feeding areas to which geese can be attracted (and scared off surrounding fields) and where they can graze in peace during the winter can minimise conflict with agricultural interests. Current investigations are seeking to identify the geese's nutritional requirements to develop grassland management options which optimise such areas for geese, whilst developing incentives to encourage the local farming community to take up this idea. The future use of chemical repellents may also be useful in managing the geese early in the winter when behaviour patterns and movements are being established for the winter.

Another local goose problem found inland is the damage to local growing crops, mainly cereals, by feral geese that disperse from estates and parks with large waterfowl collections. Thus the Canada goose (Branta canadensis), an introduced species now widely distributed, can cause serious local damage to cereals and other arable crops together with feral greylag geese (Anser anser). The Canada goose can also be a considerable nuisance on amenity grassland. The dramatic increase in Canada geese numbers suggests that management should be exercised to manipulate the population size and reduce local conflict. Humane and publicly acceptable techniques must be developed for this purpose.

RODENTS

Few farms if any in the UK are free of rats (Rattus norvegicus) and mice (Mus domesticus), the two principal commensal rodent species on agricultural holdings. The scale of the economic damage is, however, difficult to quantify. Rodents present public health hazards through the transmission of a number of important diseases including leptospirosis (Weil's disease), trichinosis and salmonella, to both man and farm stock mainly from the fouling and contamination of food and water source. While rats will consume stored grain and concentrated stock feed, together with mice they can cause considerable structural damage particularly to building insulation and electric cabling with consequent fire risks.

Warfarin-resistant rats were first identified in Scotland less than 10 years after the introduction of anticoagulants to control rodents (Boyle 1960). A second major problem area was reported on the Wales-England border and sporadically since then in southeast and central England. Outside these areas there is currently no reason why the first-generation anticoagulants should not work effectively to control rats over most of the UK. Warfarin resistance in mice is, however, a national problem. The subsequent development of new rodenticides to control rats concentrated on warfarin and analogues. The second-generation anticoagulants retain the 4-hydroxycoumarin nucleus and incorporate lipophilic side chains to increase their biological half-life and toxicity. Within a few years of the introduction of difenacoum onto the market, evidence was found of cross-resistance in warfarin-resistant rats from central southern England (Redfern and Gill 1978). This was not found to be the case in Wales where difenacoum is still effective in controlling warfarin-resistant rat populations. Today effective control of rats on farms in central southern England is difficult. Laboratory studies using feeding tests and newly developed blood-clotting response tests for resistance indicate resistance or increased tolerance to second-generation anticoagulants in this area (MacNicoll 1988). The actual cause of poor control in the field is not fully understood and this laboratory is currently carrying out a programme of trials in this area to identify and separate the contributions of resistance and rat behaviour to the difficulty of control. In view of the low priority often given to farm rodent control, the most common reason for failure of control is technique failure arising from inadequate survey, under-baiting and failure to take account of the rodents' variable behaviour patterns. Laboratory research at the ADAS Central Science Laboratory indicates that resistance to the second-generation anticoagulants is widespread in mice.

Although difenacoum and bromadiolone may be used for rodent control on farms in the UK, the two single-dose anticoagulants brodifacoum and flocoumafen are restricted to indoor control operations by professional operators. The long-term solution to the problem of anticoagulant resistance in rats and mice is to use non-anticoagulant rodenticides to remove the selection pressure for resistance. This long-term strategy identifies the need for the development of safe, effective, and humane rodenticides with an alternative mode of action.

COYPU

The feral establishment of escaped exotic species can result in serious agricultural and ecological damage. One such example is the coypu (Mvocaster coypus) which became established in the extensive wetlands of East Anglia following escapes from fur farms in the 1930s. So successful were they that their population reached a maximum of an estimated 200,000 in the late 1950s. Extensive ecological and structural damage was done by coypu to reed swamp that fringed the broads and rivers of the area. Significant crop damage also occurred. MAFF instigated an initial control programme which had some effect, but more importantly identified the need for sound ecological understanding of the population processes limiting coypu numbers (Gosling et al. 1981). The ADAS Central Science Laboratory at its Norwich Laboratory embarked on a detailed research programme involving intensive field studies and postmortem studies of trapped coypu from which the scientists built up a retrospective model of coypu population. On this solid foundation, a management control strategy was devised and implemented in 1980. The intention was to eradicate coypu within 10 years, using trappers employed by a separate organisation but with strategic direction from the Laboratory's ecologists. In 1981 there were in excess of 5,000 adult coypu in the wild. By 1986 there were less than 40 estimated to remain in the wild. The last breeding group of coypus was found in 1987 and, despite intensive trapping and validation effort since then, only three old and isolated male coypu have been found. The eradication campaign officially ended in January 1989 and monitoring effort is now being reduced (Gosling and Baker 1987). This remains a rare success story in reversing an environmental mistake and succeeded mainly because applied population biology was prominent in the sound planning and guidance through the campaign (Gosling 1989, Gosling and Baker 1989). The lesson to be learned is the need for continued vigilance to ensure that similar exotic escapes do not lead to the establishment of future problems and that, in the event, resources are rapidly invested to prevent spread.

CONCLUSION

The UK agricultural environment and the pattern of cropping and land use is a continually changing mosaic of noncropped and productively cropped areas. Within this matrix, significant vertebrate pest problems exist which require the refinement of existing management techniques and the development of new methodology. Public and political pressure requires that control techniques are as humane as possible, targeted against the pest and result in minimal environmental impact. In many cases there is an emphasis away from control (killing) towards the manipulation of animal behaviour to reduce damage to a tolerable level. These constraints have a strong influence on the future direction of successful management of vertebrate pest problems in the UK which must be underpinned by a soundly based research capability.

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LITERATURE CITED

BOYLE, C.M. 1960. Case of apparent resistance of Rattus norvegicus to anticoagulant poisons. Nature 188:157.

COWAN, D.P., A.R. HARDY, J.A. VAUGHAN, and W.G. CHRISTIE. 1989. Rabbit ranging behaviour and its implications for the management of rabbit populations. Pages 178-186 In: Mammals as Pests (R.J. Putman, Ed). Chapman and Hall, London and New York.

FEARE, C. J. 1989. The changing fortunes of an agricultural bird pest: the European starling. Agricultural Zoology Reviews (3):317-342.

FEARE, C.J., and K.P. SWANNACK. 1978. Starling damage and its prevention at an open-fronted calf yard. Animal Production 26:259-265.

GOSLING, L.M. 1989. Extinction to order. New Scientist, 4 March 1989, pp 44-49.

GOSLING, L.M., and S.J. BAKER. 1987. Planning and monitoring an attempt to eradicate coypus from Britain. Symp. Zool. Soc. Lond. 48:99-113.

GOSLING, L.M., and S.J. BAKER. 1989. Demographic consequences of differences in the ranging behaviour of male and female coypus. Pages 155-167 In: Mammals as Pests. (R.J. Putman, Ed.). Chapman and Hall, London and New York.

GOSLING, L.M., A.W. WATT, and S.J. BAKER. 1981. Continuous retrospective census of the East Anglian coypu population between 1970 and 1979. J. Anim. Ecol. 50:885-901.

INGLIS, I.R., and A.J. ISAACSON. 1984. The response of woodpigeons (Columba palumbus) to pigeon decoys in various postures: a quest for a supernormal alarm stimulus. Behaviour 90:224-240.

INGLIS, I.R., A.J. ISAACSON, R.J.P. THEARLE, and N.J. WESTWOOD. 1990. The effects of changing agricultural practice upon woodpigeon Columba palumbus numbers. Ibis 132 (in press).

INGLIS, I.R., R.J.P. THEARLE, and A.J. ISAACSON. 1989. Woodpigeon (Columba palumbus) damage to oilseed rape. Crop Protection 8:299-309.

MACNICOLL, A.D. 1988. The influence of anticoagulant resistance on effective rodent control in the UK. EPPO Bulletin 18:223-227.

MCKILLOP, I.G., H.W. PEPPER, and C.J. WILSON. 1988. Improved specifications for rabbit fencing for tree protection. Forestry 61(4):359-368.

MCKILLOP, I.G., and C.J. WILSON. 1987. Effectiveness of fences to exclude European rabbits from crops. Wildl. Soc. Bull. 15:394-401.

MURTON, R.K. 1965. The Woodpigeon. New Naturalist Monograph Collins, London.

MURTON, R.J., N.J. WESTWOOD, and A.J. ISAACSON. 1974. A study of woodpigeon shooting: the exploitation of a natural animal population. J. Appl. Ecol. 11:61-81.

REDFERN, R., and J.E. GILL. 1978. The development and use of a test to identify resistance to the anticoagulant difenacoum in the Norway rat (Rattus norvegicus). Journal of Hygiene 81:427-431.

ROSS, J., A.M. TITTENSOR, A.P. FOX, and M.F. SANDERS. 1989. Myxomatosis in farmland rabbit populations in England and Wales. Epidem. Inf. 103:333-357.

TROUT, R.C., S.C. TAPPER, and J. HARRADINE. 1986. Recent trends in the rabbit population in Britain. Mammal Review 16:117-124.

TROUT, R.C., and A.M. TITTENSOR. 1989. Can predators regulate wild rabbit Oryctolagus cuniculus population density in England and Wales? Mammal Review 19:153-174.